DISTRICT OF COLUMBIA
PUBLIC SCHOOLS
Office of the Chief Academic Officer

Summer 2010

Science Summer Learning Packet

Grades 6-8

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Introduction

The activities in this packet have been adapted from Miami-Dade County Public Schools and are aligned to DC Standards. These activities were selected to allow our students to experience science in a fun and engaging way. As you work with your child to complete these activities this summer, your child will realize that science is not only limited to the classroom. In fact, science is in our everyday lives. Science can be found outside of school and can explain many of the natural phenomena that occur around us.

Subject: Geology
Mission: Determining how acid rain weathers rocks
Adapted from *http://userpages.bright.net/~double/erode.htm*

Dear Scientist,

Congratulations! You have been selected for this mission because of your enthusiasm for learning. You will now assume the role of geologist. This important scientist studies the physical matter of Earth, including rocks and minerals. An important scientific term that you may need to know is **weathering**, which means the wearing down of rocks, soils, and minerals through direct contact with agents of Earth's atmosphere.

There has been a considerable amount of chemical pollution in the air resulting in the formation of destructive **acid rain**. Acid rain is any precipitation that is unusually acidic. This evil villain is affecting the rocks of the Earth. Is acid rain as destructive as people say? Your mission is to conduct an experiment to determine how much damage will occur to rocks near your home if acid rain continues to fall.

To complete your mission, you will assume that vinegar is acid rain.

Materials:

- Rocks (can be found outside your home or at a home supplies store)
- 2 jars with lids
- 2 bowls
- Vinegar
- Masking tape
- Marker

Procedure:

1. Place an equal number of rocks into two jars.

2. Cover the stones in one jar with water and those in the other with vinegar. Then screw lids on the jars. Be sure to use the same amount of liquid in each jar.

3. Label the jars "water" and "vinegar" using masking tape and a marker.

4. Hypothesize what will occur in both jars. Write your hypothesis on the Experiment Design table on the next page.

5. Allow the jars to stand overnight.

6. You may notice some bubbles forming in the jar with the vinegar. What does this mean?

7. The next day, pour out the liquid from each jar into separate bowls that are labeled as "water" and "vinegar."

8. Allow the liquid in the bowls to evaporate. Check back after one day to see if the liquid has evaporated. If it has not, wait another day or two for the liquid to evaporate entirely.

9. Compare the amount of solid material remaining in the two bowls. Which liquid (water or vinegar) led to more solid material remaining in the bowls?

10. Repeat the experiment with other types of rocks you find outside your home.

11. Complete the *Experimental Design* write-up and conclusion on the following page.

12. Decide if you consider acid rain to be an "evil villain." Defend your decision.

Experimental Design

Title	
Subject	
Statement of Problem	
Hypothesis	
Manipulated Variable (Independent Variable)	
Responding Variable (Dependent Variable)	
Experimental Tests	
Control Test	
Variables Held Constant	

Writing Your Conclusion

Directions: Write your conclusion with three paragraphs. Answer questions 1-3 in the introduction paragraph, question 4 in the body paragraph, and questions 5-7 in the conclusion paragraph.

1. What was investigated? (Describe the problem statement)
2. What were the major findings?
3. Was the hypothesis supported by the data?
4. How did your findings compare with other researchers (your classmates/friends)?
5. What possible explanations can you offer for your findings?
6. What recommendations do you have for further study and for improving the experiment?
7. What are some possible applications of the experiment?

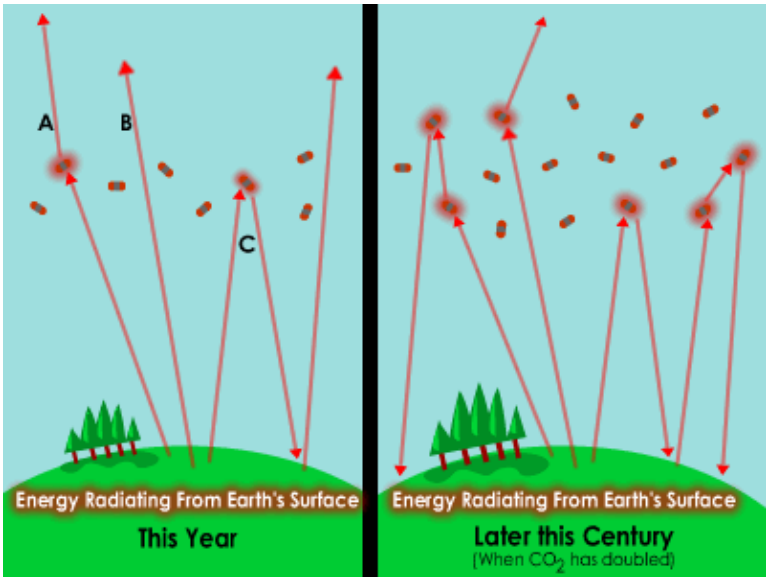
Earth's Greenhouse Effect
Adapted from: Windows to the Universe
http://www.windows.ucar.edu/tour/link=/earth/climate/earth_greenhouse.html

Directions: Try to answer the following pre-reading questions. Then read the article and determine how accurate your answers were. Complete the questions at the end of the selection as a knowledge-check of the greenhouse effect.

Pre-Reading Questions:

1. What are some current issues related to global warming and climate change that you know about?.
2. What do you predict will happen if the world's climate keeps getting hotter? Hypothesize what might happen over winter break.

Background:



(Image) Lisa Gardiner / Windows to the Universe

The Earth's surface, warmed by the Sun, radiates heat into the atmosphere. Some heat is absorbed by greenhouse gases like carbon dioxide and then radiated to space (A). Some heat makes its way to space directly (B). Some heat is absorbed by greenhouse gases and then radiated back towards the Earth's surface (C). With more carbon dioxide in the atmosphere, more heat will be trapped by greenhouse gases, warming the planet.

Energy from the sun that makes its way to the Earth's surface can have trouble finding its way back out to space. This is because of a natural process called the **greenhouse effect**. The greenhouse effect is what occurs when energy leaving Earth's surface is trapped by special gases called greenhouse gases and is rereleased to the Earth's surface. Without the greenhouse effect, Earth's temperature would be below freezing. However, Earth's greenhouse effect is getting stronger as we add more greenhouse

gases to the atmosphere. This is contributing to the warming of the **climate**. Climate is different from weather because climate refers to the weather of a given region over long periods of time.

Heat is radiated back into the atmosphere from the Earth's surface. As the heat makes its way back to space, much of it is absorbed by greenhouse gases in the atmosphere. **Greenhouse gases** are more complex than most other gas molecules in the atmosphere because they can absorb heat. They radiate the heat back to the Earth's surface, to another greenhouse gas molecule, or out to space. During this century, the amount of carbon dioxide (CO_2), a type of greenhouse gas, in the atmosphere is expected to double.

Other greenhouse gases like methane and nitrous oxide are increasing as well. The quantity of greenhouse gases is increasing as fossil fuels are burned, releasing these and other air pollutants into the atmosphere. Fossil fuels such as coal, oil and natural gas were formed in the Earth over millions of years. Greenhouse gases also make their way to the atmosphere from other sources. Farm animals, for example, release methane gas as they digest food. As cement is made from limestone, it releases carbon dioxide.

With more greenhouse gases in the air, heat passing through on its way out of the atmosphere is more likely to be stopped. The added greenhouse gases absorb and then radiate the heat. Some of the heat will head away from the Earth, some will be absorbed by another greenhouse gas molecule, and some of it will wind up back at the planet's surface again. With more greenhouse gases, heat will stick around, warming the planet.

Post-Reading Questions:

1. Determine the author's purpose for writing the article.

2. Explain radiation.

3. What part does the atmosphere play in keeping the Earth's surface temperature in most areas of the world above freezing?

4. Whose responsibility is it to control the amount of carbon dioxide (CO_2) released in the atmosphere?

5. Develop a logical argument for reducing the use of fossil fuels, such as gasoline and coal.

6. How does the energy from the sun affect the temperature of the air, water, and land?

7. The article discusses climate change. How is climate different from weather?

8. BONUS: Write or produce a 30-60 second commercial, ad jingle, or print advertisement to increase public's awareness of the connection between increasing CO_2 emissions and climate change.

Exploring Acids and Bases
Adapted from: http://www.sciencefairprojects-ideas.com

Directions: Read through the activity and complete the experimental design worksheet. After completing the experimental design worksheet, conduct the experiment. Once you have your results, write your conclusion, using the questions as a guide.

Background: Acids are chemical solutions that have a lower pH than the neutral pH of 7. Pure water has a neutral pH of 7. Examples of acids you have come across are vinegar and lemon juice. **Bases** (also called alkalis) are chemical solutions that have a higher pH than the neutral pH of 7. Cleaning liquids with ammonia are examples of bases. In these experiments, you will investigate some of these properties with materials that are found around your home. In addition, you will learn how chemists use the **pH scale** to describe acids and bases. One property of both acids and bases is their ability to change the color of certain vegetable materials. A common vegetable whose color responds to acids and bases is red cabbage.

Materials:

- 2 cups of red cabbage
- Water
- Strainer
- Drinking glasses (at least 3)
- Vinegar
- Baking soda
- Sprite or 7-Up
- Lemon juice
- Milk
- Liquid detergent
- Salt water (1 tablespoon dissolved in 1 cup of water)
- Sugar water (1 tablespoon dissolved in 1 cup of water)
- Milk of magnesia
- Antacid tablet dissolved in water
- Aspirin, crushed and dissolved in water

Preparation for acid-base indicator:
Prepare an extract of red cabbage so you can investigate its color changes.

1. Place about 2 cups of red cabbage cut into 1-inch pieces into a blender.
2. Add about 1 cup of water and blend the mixture until the cabbage has been chopped uniformly into tiny pieces.
3. Strain the mixture by pouring it through a strainer. This strained liquid, the red-cabbage extract, will be used for exploring acids and bases.

Let's see how acids change the color of the red cabbage extract.

4. Pour ½ cup of vinegar into a colorless drinking glass.
5. Add 1 teaspoon of red cabbage extract, stir the mixture, and note its color. What is the color of the mixture?
6. Record your answer in the data table.
7. The color of the cabbage extract with vinegar is the color the extract has when it is mixed with an acid. Save the mixture in this glass to use as a reference in the rest of the experiment.

Now test the properties of a base, baking soda.

8. Place 1 teaspoon of baking soda in a glass and add ½ cup of water.
9. Stir the mixture until the baking soda has dissolved.
10. Add 1 teaspoon of red cabbage extract to the solution.
11. Write the color of the mixture in the data table

Baking soda is a base. The color of this mixture is the color of cabbage extract when it is mixed with a base. The color of cabbage extract indicates whether something mixed with it is an acid or a base. Therefore, cabbage extract can be called an **acid-base indicator**. Save the mixture in this second glass to use as a reference.

Red cabbage extract can indicate whether a substance is an acid (like vinegar) or a base (like baking soda). It can also show how strong an acid or a base a substance is. Chemists use the **pH scale** to express how acidic (like an acid) or basic (like a base) a substance is. A pH value below 7 means that a substance is acidic, and the smaller the number, the more acidic it is. A pH value above 7 means that a substance is basic, and the larger the number, the more basic it is. Red cabbage extract has different colors at different pH values. These colors and approximate pH values are:

Approximate pH:	2	4	6	8	10	12
Color of extract:	Red	Purple	Violet	Blue	Blue-Green	Green

Image from knol.google.com/k/chemistry-demos

Use the instructions for testing vinegar and baking soda to test the pH of several other nearly colorless liquids, such as lemon-lime soft drink (Sprite or 7-Up) and lemon juice. Record your observations. Liquids that are white, such as milk, can be tested in the same way. You can also test solids that dissolve in water by following the instructions for baking soda (see page 2). This will also work with viscous liquids such as liquid detergents. Test other substances around the house, such as sugar, table salt, shampoo, conditioner, milk of magnesia, antacid tablets, and aspirin.

Material	Extract Color	Approximate pH
Vinegar		
Baking Soda		
Sprite or 7-Up		
Lemon Juice		
Milk		
Liquid detergent		
Salt		
Sugar		
Milk of Magnesia		
Antacid tablet		
Aspirin		

CAUTION: Some household products can cause skin irritations. Do not allow these products to contact skin; rinse thoroughly with water if they do.

Reflecting on your observations:
Write your observations in a three-paragraph format. Answer questions 1 and 2 in the introduction paragraph, include data in the body paragraph, and questions 3-5 in the conclusion paragraph.

1. What was investigated? (Describe the problem.)
2. What were the major findings?
3. What possible explanations can you offer for your findings?
4. What recommendations do you have for further study and for improving the experiment?
5. What are some possible applications of the experiment?

Sinking and Floating Soda Cans
Adapted from: http://www.scifun.org/homeexpts/cans.htm

Directions: Read through the activity for "Sinking and Floating Soda Cans." Complete the experimental design worksheet. Following the experimental design worksheet, conduct the experiment. After conducting the experiment, write your conclusion, using the conclusion questions as your guide.

Background:
Imagine a hot summer day. You're at a picnic and go to the ice chest where the sodas are staying nice and cool. Which cans are floating in the ice water, and which have sunk to the bottom?

The cans of regular and diet soda have exactly the same volume, but their density differs due to the type of sweetener found in the soda. Regular soda contains sugar as a sweetener. The nutrition label on a can of regular soda shows that it contains sugar...a lot of sugar. Some cans of regular soda contain over 40 grams of sugar. Diet sodas, on the other hand, use artificial sweeteners such as aspartame. These artificial sweeteners may be hundreds of times sweeter than sugar, which means that less than a few grams of artificial sweetener is used per can.

For this experiment you will need:
- several unopened cans of regular soda of different varieties
- several unopened cans of diet soda of different varieties
- a large aquarium or sink

Procedures
1. Fill the aquarium or sink almost to the top with water.
2. Place a can of regular soda into the water. Make sure that no air bubbles are trapped under the can when you place it in the water.
3. Create a chart to show the type of soda (cola, root beer, orange soda), whether it's regular or diet, and to indicate whether the can sinks or floats.
4. Record your observations in the chart.
5. Repeat the experiment with a can of diet soda.
6. Record your observations in the chart.
7. Repeat the experiment two more times with different types of sodas.
8. Complete the Experimental Design and write a conclusion to the experiment based on the questions on the next page.

Think about it
1. Why does one can sink, and the other can float?
2. Take a look at the nutrition facts on each can of soda. Write your observations.

Experimental Diagram

Title	
Statement of Problem	
Hypothesis	
Manipulated Variable (Independent Variable)	
Responding Variable (Dependent Variable)	
Variables Held Constant	

Writing Your Conclusion

Directions: Write your conclusion in three paragraphs. Answer questions 1-3 in the introduction paragraph, question 4 in the body paragraph, and questions 5-7 in the conclusion paragraph.

1. What was investigated? (Describe the problem statement)
2. Was the hypothesis supported by the data?
3. What were the major findings?
4. How did your findings compare with other researchers (friends or classmates who conducted the same experiment)?
5. What possible explanations can you offer for your findings?
6. What recommendations do you have for further study and for improving the experiment?
7. What are some possible applications of the experiment?